# GLOBAL WARMING

*Towards a Strategy for Ontario*

Ontario Ministry of Energy

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## MINISTER'S MESSAGE

*I am pleased to present for public review this discussion paper of the Government of Ontario on a proposed strategy on global warming.*

*Global warming must clearly be seen as a challenge to sustainable development. The issue is complex, and it has many uncertainties and risks. High levels of co-operation among nations and regions will be needed. Global warming demands the attention of all of us, as we are all contributors to the problem, and we all must play a role in acting to address it.*

*This discussion paper builds on the theme of shared responsibility and proposes a number of potential first steps. As part of a consultative process, we are challenging the Ontario public to comment on these proposals and to suggest additional ideas. The approach taken in the discussion paper is to identify some initial measures that are worth doing in their own right. More such actions are needed, on the part of all of us, not just governments.*

*The ideas proposed here, and others that will emerge during the next several months of public discussion, will help the Province in considering its policy directions for the future. The discussion paper indicates a series of milestones that, together with their timing, must also be a focus of consultations:*

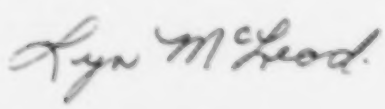
- *slowing the annual growth rates of the greenhouse gas emissions,*
- *stabilizing emissions levels so they do not rise,*
- *beginning to reduce annual emissions levels,*
- *achieving reductions approaching the "20 per cent reduction" recommended at the 1988 Toronto Conference,*
- *ultimately, achieving reduced levels of emissions consistent with global stabilization of concentrations in the atmosphere.*

*The 1988 Toronto Conference on the Changing Atmosphere focused mainly on carbon dioxide and the chlorofluorocarbons. This discussion paper is a first step in recognizing the roles of all the greenhouse gases in global warming.*

*Over the next six months, we will be inviting citizens, businesses, and public interest groups to engage in the public dialogue:*

- *beginning in March, the Select Committee on Energy of the Legislative Assembly will hold hearings on global warming*
- *in late spring, there will be a Workshop on Limiting Global Warming*
- *staff officials will conduct extensive consultations across Ontario with the public*
- *a toll-free telephone "hotline" is available for your comments*
- *written comments on the discussion paper are invited before July 31, 1990.*

*Depending on the response of the public to this discussion paper, I anticipate the public release of a policy paper, a "White Paper", on global warming by the end of 1990. I look forward to your contributions to this effort to look beyond our needs to those of our children—and theirs.*



*Honourable Lyn McLeod,*
*Minister of Energy*

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# I. INTRODUCTION

*"Everyone talks about the weather but no one does anything about it."*

— Mark Twain

Our climate is ever-changing, but now human activities may have become a major cause of change. All of us, by using fossil fuels, *are* doing something about the weather, and it isn't good.

There is a strong consensus in the international scientific community that human activities, mainly related to the use of energy, are contributing to the "greenhouse effect". The greenhouse effect may be warming the Earth and its atmosphere; this is called global warming.

The greenhouse effect is the trapping of heat by some gases that make up only a small part of the atmosphere but that absorb a great deal of heat. The main greenhouse gases are carbon dioxide, methane, nitrous oxide, low-level ozone, and chlorofluorocarbons (CFCs). Carbon dioxide emissions account for about half of the greenhouse effect. The burning of fossil fuels causes most of the carbon dioxide emissions.

The greenhouse gases contribute to the heating of the atmosphere, but many other factors like changes in the Earth's orbit around the sun also affect our climate. It is uncertain whether human-caused effects like emissions of greenhouse gases affect global climate as much as natural processes do.



The amount of global warming that may happen, and how fast, are not certain. But the potential effects of global warming may be serious

for the world's economies; global warming is often regarded as the single greatest challenge facing sustainable development.

Global temperatures may increase by 1.5° to 4.5° C within 50 years. While many may look forward to milder winters and longer summers, many other impacts may also come with global warming. Some of these effects will be truly global, like effects on the oceans and clouds. Others will be regional, like temperature increases higher in northern areas than in areas closer to the equator.

The range of possible impacts is very broad, and there are many uncertainties about what might happen. The sea levels will rise while the Great Lakes levels fall. Storms may become more prolonged and intense; floods and erosion may increase; summer dry periods may lengthen; groundwater levels may fall and water quality may suffer; the northern permafrost may melt and turn to bogs; previously trapped greenhouse gases like methane could be released in large amounts, accelerating the warming; plant and animal species may have to adapt and change habitats.

What are the signs that global warming is happening? The average global temperature may have risen by about 0.5° C since 1860. But, of course, the annual difference between winter and summer is more than 20° C, far larger than what the greenhouse effect may be causing, so the trend is hard to discern.

Other signs of a warming trend are rises in the average sea level, which can be masked by daily tides; the retreat of glaciers in the northern hemisphere; and the increasing depth to reach permafrost. All these signs are evidence of global warming, but they are not proof.



Global warming from the greenhouse gases, though it may seem gradual, would be far faster than the kinds of changes the Earth's climate naturally undergoes. Since the end of the last ice age about

10,000 years ago, the Earth's temperature has risen about 5° C. Because of global warming, our grandchildren may be living with a similar rise in temperature.

This prospect of rapid change, happening all around the world, led the Conference on the Changing Atmosphere held in Toronto in June 1988 to conclude:

> "Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war. The Earth's atmosphere is being changed at an unprecedented rate by pollutants resulting from human activities, inefficient and wasteful fossil fuel use and the effects of rapid population growth in many regions. These changes represent a major threat to international security and are already having harmful consequences over many parts of the globe."

The potentially serious impacts of climate change demand a prudent course of managing these risks. This discussion paper proposes for public review a strategy for Ontario to deal with global warming.

# II. THE INTERNATIONAL CONTEXT

> *"To secure our common future, we need a new international vision based on cooperation and a new international ethic based on the realization that the issues with which we wrestle are globally interconnected. This is not only a moral ethic, but also a practical one—the only way we can pursue our own self-interests on a small and closely knit planet."*
>
> — Gro Harlem Brundtland

Global warming is a prime example—acid precipitation and depletion of stratospheric ozone are two others—of environmental effects that go beyond regional and national boundaries. They all need co-operative solutions. But global warming poses a different, greater threat to sustainable development: all of society is involved in the generation of the greenhouse gases, which come from the use of fossil fuels, the use of CFCs, and deforestation.

Sustainable development is often regarded as meeting the social and economic needs of today without compromising the ability of future generations to meet their needs. A stable climate, or at least one changing slowly enough for future generations to adapt, is a key feature of sustainable development.

Energy policy is the backbone of achieving climate stability because the burning of fossil fuels releases most of the greenhouse gases, mainly carbon dioxide. Carbon dioxide accounts for about half of the greenhouse effect.



Energy use also affects emissions of the other greenhouse gases. And

there are sources other than energy use. Methane, much of which is emitted from landfills, is more than 20 times more powerful as a greenhouse gas than carbon dioxide. The methane is now collected for reasons of safety, but is often vented into the air. Even burning, not venting, the methane to produce more carbon dioxide would contribute less to global warming.

Nitrous oxide is emitted by combustion of fossil fuels and also when fertilizers are used in agriculture. Steps to improve the efficiency of fossil fuel use will also reduce levels of nitrous oxide.

Ozone in the lower atmosphere is the result of chemical reactions between other gases and pollutants emitted during fossil fuel burning, in large part by automotive vehicles. Vehicle emissions in Canada will soon be subject to stringent controls equivalent to California standards, but improved fuel economy leading to use of less fossil fuel would also reduce ozone levels in urban areas.

Emissions of these greenhouse gases—carbon dioxide, methane, nitrous oxide, and ozone—are closely tied to the burning of fossil fuels. Steps to improve the efficiency of using fossil fuels will also reduce other air pollutants such as the nitrogen oxides and carbon monoxide.

The chlorofluorocarbons are different. CFCs are used as industrial chemicals, and they do not occur naturally in the environment. CFCs deplete the upper, stratospheric ozone layer that shields the Earth from part of the sun's ultraviolet radiation. CFCs also act as powerful greenhouse gases and are long-lived in the atmosphere. By signing and ratifying the Montreal Protocol, Canada has already committed to a reduction in CFCs by 50 per cent from 1986 levels by the year 1998. Faster phase-out will reduce the greenhouse effect as well as protect the stratospheric ozone layer.

The industrialized countries account now for more than two-thirds of the world's annual energy use. The developing countries, many with quickly growing populations, are becoming more significant users of energy and larger contributors of greenhouse gases.

Canada is a very energy-intensive country by international standards. Canada uses the most energy per person in the world and the most energy per unit of economic output among the industrialized countries. Canada's energy intensity has declined since 1973, but not as much as intensities of other countries like Sweden and Japan.

As a result, Canada is among the world's largest emitters of carbon dioxide on a per person basis. Still, our population is small, being less than 0.5 per cent of the world's total, so that Canada accounts for about 2.5 per cent of the world's energy-related carbon dioxide emissions.

In Canada, Ontario is the most industrialized and largest energy-using province. We are also dependent on fossil fuel resources for more than 80 per cent of our energy use. We have a special responsibility to be efficient in our use of energy. At the same time, it will save us money.

No matter how energy-efficient we become, actions taken in Ontario and in Canada to limit global warming can be only a small part of the solution. International steps taken together, especially by the industrialized countries, are essential.

The best-known statement of the need now for international actions is the call for action by the Conference on the Changing Atmosphere in Toronto in June 1988, which focused on CFCs and carbon dioxide:



- "Ensure nearly complete elimination of the emissions of CFCs by the year 2000;

- "Stabilizing the atmospheric concentrations of carbon dioxide is an imperative goal; and
- "Reduce carbon dioxide emissions by approximately 20 per cent of 1988 levels by the year 2005 as an initial global goal. Clearly, the industrialized nations have a responsibility to lead the way."

This last recommendation, the "20 per cent reduction of carbon dioxide by 2005 as an initial goal", has become a key message of environmental interest groups in Canada and around the world.

The "20 per cent reduction" for Canada was found to be clearly ambitious by the Federal/Provincial/Territorial Task Force on Energy and the Environment in August 1989. As an example of how ambitious such an "initial goal" for Canada would be, the Task Force estimated that achieving it in 2005 would require a reduction of 46 per cent from the expected emissions of carbon dioxide in 2005. That reduction, in megatonnes of carbon dioxide, would amount to 69 per cent of the actual emissions in 1988, an extremely large reduction to achieve in 15 years. Energy Ministers agreed that actions to reduce greenhouse gas emissions are worth taking, and they directed that regional assessments of opportunities and impacts be undertaken.

What is happening on the international scene? Under the sponsorship of the United Nations, an international convention and protocols, similar to the Montreal Protocol for CFCs, are being developed.

Several industrialized countries have begun to take steps. Norway took the first step in spring 1989 and declared a target of stabilizing carbon dioxide emissions at some future level higher than today's by no later than 2000. Stabilizing emissions means stopping the annual increase and preparing for annual reductions after 2000.



The Netherlands have adopted the most ambitious national target to date, reducing expected emissions of carbon dioxide to 1989 levels by

1995, with annual reductions after that. The Dutch will also eliminate CFCs by 1998, in advance of the Montreal Protocol provisions.

No national government has adopted the "20 per cent reduction by 2005" as a target, together with actions to achieve it. The states of Victoria and New South Wales in Australia have adopted it "as an interim objective for planning purposes." The City of Toronto has made a commitment to achieve an initial net reduction of 20 per cent of carbon dioxide emissions by 2005.

Achievement of such a target in Ontario would require large reductions in energy use and significant regulatory and tax changes, many of them outside the control of the Province. For example, many public interest groups have suggested a "carbon tax" on fossil fuels, proportional to the amount of carbon. As well, such an ambitious target would need federal regulations to improve vehicle fuel efficiencies by at least 35 per cent for all autos in Canada by 2005.

Although national and international co-ordination is essential to achieve major reductions in greenhouse gas emissions, Ontario can take a leadership role in Canada with actions to limit global warming. These actions would be a first step in fulfilling the recommendations of the Toronto Conference on the Changing Atmosphere.

In view of our level of economic development and state of technology, leadership by Canadians is a moral responsibility and a practical one. The developing countries, which have growing populations and economic development needs, can join global efforts to address global warming only with the assistance of the industrialized countries such as Canada.



What will that leadership cost? Why should we be among the first in the world? And what if global warming is not really happening, or is driven by causes other than the greenhouse effect? We live in a

competitive economic and trading environment, and the quality of our lives in Ontario depends on our economic competitiveness.

Energy is a vital part of the Ontario economy, and its efficient use helps our competitiveness. So, for example, an energy-efficient steel industry uses lots of energy and is important to the economy. In using energy, it emits greenhouse gases. It would make no sense to reduce our energy use by stopping the making of steel, as steel would be made somewhere else with perhaps greater use of energy and more greenhouse gas emissions world-wide.

So reducing energy use in Ontario is *not* an objective by itself. Reducing our emissions from energy use while maintaining, and contributing to, greater economic competitiveness *is* an objective. And many energy-efficiency steps that improve competitiveness will pay for themselves.

With care and commitment, we can begin taking actions to reduce net emissions of the greenhouse gases, steps that are *worth doing in their own right*. These actions will take us in the direction of achieving the Toronto Conference recommendations.

Measures to save energy are good examples; so are measures that cut down the chlorofluorocarbons that deplete the ozone layer; so are steps to cut down other kinds of air pollution and to increase reforestation. The place to start is to do what is sensible anyway. Those steps will help our economic competitiveness no matter what the pace of global warming turns out to be.

# III. PROPOSALS FOR ONTARIO

> *"Generations come and generations go, but the earth remains for ever. The sun rises and the sun sets, and hurries back to where it rises. The wind blows to the south, and turns to the north; round and round it goes, ever returning on its course. All streams flow into the sea, yet the sea is never full. To the place the streams come from, there they return again."*
>
> — Ecclesiastes 1:4-7

This natural balance of the Earth's air, seas, and land is threatened by global warming. To limit the effects of global warming, this discussion paper proposes a Goal, a set of Principles, and a set of Action Steps.

But this discussion paper is something more:. it is also a call *to* action by other governments, by business and industry, and by each of us as citizens, to do what is worth doing anyway but with a focus on limiting global warming. Governments can take enabling steps, but by themselves these steps will go only part way to fulfilling the Toronto Conference recommendations. The actions to limit global warming must come from all of society. All of us must be part of the solution.

## Goal

Global warming is truly an example of an environmental effect to which we all contribute and that we can all help to reduce. No one bears sole responsibility, and no one alone can solve the problem.

Concentrations in the air of all the greenhouse gases have risen rapidly in recent years. Even if greenhouse gas emissions around the world were to be cut to zero now, scientists estimate that there may be global warming of several degrees within 50 years because of the concentrations already in the air. Thus, we need to begin now, even to minimize the costs of dealing with whatever levels of warming may be underway already.

Ontario's proposed goal is:

> **To provide leadership in stabilizing concentrations in the atmosphere of the greenhouse gases, while minimizing the social, economic, and environmental costs in Ontario of adapting to global warming.**

This goal of *stabilizing concentrations* of the greenhouse gases in the air goes beyond stabilizing or even reducing *emissions* by some amount by some time. And it is broader than just stabilizing the concentrations of carbon dioxide, which was cited as an imperative goal by the Toronto Conference.

This is a long-term goal that needs to be adopted globally to limit temperature increases. To achieve it will take many years of progressive reductions of emissions, and this is the commitment proposed in this discussion paper.

We in Ontario can make only a small direct contribution to stabilizing global concentrations in the air, but we can reduce our own net emissions.

A proposed first step to address global warming is:



> **To achieve reductions in expected emissions of the greenhouse gases, especially carbon dioxide, so that levels by the year 2000 are lower than in 1989.**

Achieving reductions in expected emissions of all the greenhouse gases by 2000 so that there is no overall increase compared with 1989 is ambitious because these emissions have been rising steadily, some at rates of 0.5 per cent each year and others at more than 5.0 per cent each year.

Energy use accounts for nearly all the emissions in Ontario of carbon dioxide, which accounts for about half of the greenhouse effect. Energy demand, without an attempt to limit global warming, is projected by the Ministry of Energy to increase by about 2 per cent each year, leading to an increase from 1988 to the year 2000 of 27 per cent and to 2005 of 38 per cent.

To move in the direction of achieving the Toronto Conference recommendations of stabilizing concentrations of carbon dioxide and of a "20 per cent reduction by 2005", there are several milestones along the way, to measure progress:

- lowering the rates of growth of annual emissions
- stabilizing emissions levels so that they do not rise
- beginning to reduce annual emissions levels
- reducing annual emissions to today's levels
- achieving reductions approaching the Toronto Conference recommendation of "20 per cent reduction"
- ultimately, achieving reduced levels of emissions consistent with global stabilization of concentrations in the atmosphere.

Thus, the proposed first step, getting the emissions of all the greenhouse gases back down to 1989 levels, would be a significant accomplishment, well on the road to fulfilling all of the 1988 Toronto Conference recommendations.

Reducing expected emissions of carbon dioxide to today's levels by 2000 would take significant efforts to be more efficient in the use of fossil fuels and electricity, to increase reforestation, and to develop energy technologies that do not contribute to global warming. Many of these efforts will be cost-effective in their own right, but some will face market and institutional barriers that will need to be addressed.

Reducing the expected emissions of all the greenhouse gases to limit global warming will require more than just improved energy efficiency and one-shot efforts. It will take structural changes to our economy and lifestyles such as more use of public transportation and perhaps a higher relative price of energy to reflect environmental costs.

To reduce the greenhouse effect of the CFCs as well as to help protect the stratospheric ozone layer, we can act faster than required by the Montreal Protocol, as recommended by the Toronto Conference. Another step to limit global warming is:

> **To phase-out the use of CFC 11, CFC 12, CFC 113, CFC 114, and CFC 115 by the year 1998.**

These CFCs are used in refrigerants, foam packaging and insulation, foam cushions, and solvents. Other CFCs and the halons, mainly used as fire extinguishants, also contribute to global warming, but substitutes are not yet commercially available.

## *Actions Now Underway*



Many actions already being taken in Ontario, originally for other reasons, have been helping to reduce the greenhouse effect. These include both policies and program efforts.

Examples of policies and regulations are:

- some of the current controls on automotive emissions;
- the regulations in place requiring energy-efficient performance of several appliances including electric hot water heaters;
- improvements in the Ontario Building Code affecting new homes;
- Ontario Hydro's current policy of replacing trees removed in the construction of power transmission corridors;
- Ontario Hydro's adoption of a target to reduce electricity demand by 3500 megawatts by the year 2000 through a mix of information, energy audits, design, and incentives to electricity users; and
- the graduated "gas guzzler" tax on autos using more than 9.5 litres/100 km.

In addition, nearly all uses of CFCs as aerosol propellants and as blowing agents in foam packaging have been phased out.

Current program actions that also help to limit global warming include the efforts by governments and industries to reforest and to prevent forest fires; the efforts by the Government and some utilities to encourage energy conservation through energy audits and incentives to buy efficient equipment; and the investments being made each day by energy users in many kinds of energy-efficient equipment.

These existing efforts are already extensive. Overall, Ontario's energy intensity, or energy used per unit of economic output, has declined by more than 20 per cent since 1973.

But these efforts are clearly not enough, since total energy use and the greenhouse gas emissions have been increasing. Now, to limit the impacts of global warming, new actions by all the players in the economy, not just the Government, are needed.

## New Initiatives

The Government and Ontario Hydro have already made public commitments to proceed with several new actions:

1. Establishment of minimum energy efficiency performance requirements by summer 1990 for additional products sold in Ontario. Revised regulations will be enacted to be in effect by 1994, at least in step with comparable U.S. regulations:

refrigerators and freezers
space-heating furnaces and boilers
commercial lighting
electrical motors
air conditioners
natural gas hot water heaters.

2. Restriction of the use of CFC 113 as solvents and cleaners.

3. Phased reductions in the use of CFCs in foam insulation and flexible foams.

4. Reduction between 1990 and 1994 of peak-day electricity use in Ontario by 851 megawatts, which is also roughly the amount to be supplied by one nuclear unit at Darlington. This reduction will be achieved through programs by Ontario Hydro in the residential/agricultural, commercial, and industrial sectors. The programs are budgeted at $917 million, in 1989 dollars.

Additional actions are being proposed for public discussion. Several of these relate to possible changes in areas of Government responsibility. Most, however, are enabling actions by the Government, steps that make it possible for businesses and citizens to take part in limiting global warming. And additional proposals for independent actions are welcome.

A set of principles for this enabling strategy, which emphasizes the shared responsibility to limit global warming, guides the choice of action steps. Although global warming may be a major cause of international insecurity, it is by no means the only priority for energy policy or environmental policy. The following principles are proposed to guide policy trade-offs.

## *Principles*

1. **National and International Co-ordination**

Acting alone, Ontario can affect only a small part of the global warming problem. But if we lead by example, and apply our human and technological resources to reduce global warming by actions at home, we may advise and encourage other jurisdictions to join with us to address this global issue. Economic competitiveness will be less of a barrier to action, if efforts are co-ordinated internationally. We will assist the federal government to secure international co-operation to limit global warming.

2. **Public Education and Consultation**

Understanding by all parts of Ontario society is a key to success. Global warming is complex and has many uncertainties. Actions to limit global warming will also have far-reaching effects. That's why Ontario's strategy on global warming must evolve through active participation by the public. Only through such consultation will there be broad public commitment to the solutions. Inevitably, there will be tough choices.

3. **Involvement of All Sectors of Society**

To limit global warming and its effects, no one can do it all. For Ontario's efforts to lead to global action, all sectors of our society must take action—not just governments, not just business and industry, not just individual citizens, but all of us. We are all stakeholders. We all have roles to play because we all contribute to the problem. Our success in responding to the challenge of global warming will depend on how well each sector of society is able to respond.

4. **Cost-Effectiveness**

The first actions to take are those that are economic in their own right. These include actions, like many steps to improve energy efficiency, that will save money and be attractive for investments by citizens and businesses. Such actions help, not hinder, our economic competitiveness. Other steps, such as planting trees in urban areas, will be sensible but will cost money. Other possible steps, like extra charges on energy or on transportation, might affect economic competitiveness. The public will accept such steps to limit global warming only if cost-effectiveness is assured.

5. **Fairness and Common Sense**

Actions to limit global warming, or to adapt and adjust, will require changes by everyone, perhaps at different times and to different extents. Responsibilities must be shared. The actions must be practical and acceptable to a broad range of interest groups. Narrow self-interests will not dictate the pace or content of policies to address global warming. Energy consumers in Canada have expressed a willingness to have environmental costs included in the prices they pay—but *only* if the revenues are spent on actions to limit global warming and its effects.



6. **Deeper Understanding**

There are many scientific uncertainties about global warming, its impacts, and the technologies that will help. New technologies and

changed lifestyles will be important as we gain experience in changing how our society uses energy. Research will be essential both to reduce uncertainties about the impacts of global warming and to develop new technologies. But we must be ready to act now and to adapt as new research results become available.

7. **Responsibility to Future Generations**

In working for a better life today, we often overlook the needs of future generations. Global warming may be unstoppable unless we act in concert around the world. It will be a test of our resolve to leave the world a better place for our children and our children's children. Our choices today will determine their climate tomorrow.

These seven principles will guide our choice of Action Steps.

## *Action Steps for Consideration*

To move in the direction of fulfilling the recommendations of the Toronto Conference, the Province's objectives are to:

A. Reduce emissions of greenhouse gases,
B. Absorb carbon dioxide, and
C. Conduct and stimulate research and analysis.

This paper proposes for discussion a number of actions to meet these objectives. But it also challenges all members of the public to suggest additional ones, to comment on the possible costs and benefits, and to comment on timing.

### *A. Reducing Emissions of Greenhouse Gases*

These proposed actions are related mainly to improved energy efficiency and energy conservation[1]. Some affect policies and regulations; others are program and partnership efforts.



[1] There is no sharp dividing line between "efficiency" and "conservation". Improving energy efficiency generally refers to getting the same result by using less energy: investing in a more

### *Policy and Regulation*

1. Requirement by 1994 that all new, electrically heated residential units will meet energy efficiency performance levels representing an improvement of 50 per cent from 1990 requirements of the Ontario Building Code.

2. Requirement by 1995 in the Ontario Building Code of improved energy efficiency requirements for new residential buildings so that energy consumption in new homes will be reduced by 50 per cent from levels in homes meeting the 1990 Code requirements.

3. Establishment for the first time in the Ontario Building Code, energy efficiency requirements for new commercial buildings, including levels of insulation, thermal quality of windows, and efficiency of heating/cooling/distribution systems.

4. Requirement that all municipal streetlighting will be energy efficient by using high-pressure sodium lighting by 1998.

5. Requirement for the methane collected from landfills to be burned, not vented. Demonstrations of use of the collected methane as an energy source at large landfills.

6. Regulatory allowance of expenditures by utilities for energy conservation to earn a rate of return.

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expensive but more efficient light bulb; keeping the house just as warm by using more insulation but less fuel; driving a more fuel-efficient car; keeping tires pumped-up and the engine tuned-up; using public transportation more frequently; cutting down on wasteful practices. "Conservation" of a resource usually means using less, or preserving that resource, even if that means less useful benefit, though energy is strongly linked to nearly all economic activities. While greater efficiency clearly conserves energy, "energy conservation" generally means changing current ways of doing things, not just being efficient: collecting landfill gas to be used as fuel; orienting new housing to use solar energy; providing more public transportation facilities; providing technical information on using energy, like industrial or home energy audits.

7. Requirement of a label on all new vehicles sold in Ontario listing the estimated emissions of carbon dioxide to travel 20,000 km each year.

8. Requirement of a label on all furnaces installed in new houses listing the estimated annual emissions of carbon dioxide.

9. Development of means to monitor and report on annual emissions of carbon dioxide and use of CFCs by public agencies.

### *Programs and Partnerships*

10. Development of a broad range of additional policies and programs to enhance energy-efficiency in Ontario, which would include public education on saving energy.

11. Establishment of telephone hotlines and computer matching systems for carpooling and ridesharing in all metropolitan areas of over 250,000 population and in small, compact areas.

12. Wide expansion of favoured treatment of high-occupancy vehicles like buses and carpools on roads in all metropolitan areas of over 250,000 population and where appropriate.

13. Demonstrations of means to increase the use of public transportation by shifting peak-hour usage through alternative work arrangements and by increasing transit system capacity and efficiency through improved technologies.

14. Demonstrations of reduced use of agricultural fertilizers and increased composting on farms.



15. Establishment of a co-operative program of the Province, municipalities, and industry to ensure recovery of designated CFCs used as

refrigerants from all equipment when disposed—refrigerators, freezers, air conditioners.

16. Development of co-operative programs among the Government, businesses, and environmental organizations of public education on the greenhouse effect, global warming, and community action.

These are some steps that the Government could take in co-operation with others. Many other actions to reduce emissions on the part of individuals and businesses are possible. Suggestions from all sectors of the public are encouraged.

### *B. Absorbing Carbon Dioxide*

The net emissions of carbon dioxide released into the air can be reduced by planting and growing more trees, which absorb large amounts of carbon dioxide as they grow. Planting trees, no matter how many, will not completely off-set the emissions of carbon dioxide from burning fossil fuels. But trees will help.

Most large scale planting of trees in Ontario has been for commercial reasons, to assure a sustainable forest resource. These efforts can be combined with greatly expanded tree-planting, including in urban areas, to absorb carbon dioxide and to reduce needs for air conditioning of homes. At the same time, supplies of seedlings from nurseries will need to be greatly increased. These proposed actions are only part of the overall efforts needed.

#### *Policy and Regulation*

1. Expansion of reforestation efforts in forest areas reduced by harvesting, fires, or other natural causes. This will involve federal funding in addition to Provincial and private sector funds.

2. Adoption of a policy to replace all trees removed for building highways in Ontario.

3. Expansion of Ontario Hydro's reforestation policy and program to replace all trees cleared in future construction of its facilities, including headponds of hydro-electric dams.

4. Requirement that all agencies, public and private, plant trees to replace those cut down for construction of facilities. Requirements will be included in zoning bylaws and, for regulated utilities, in orders of the Ontario Energy Board.

5. Annual reporting by public agencies and commercial forest users of net additions to Ontario's stock of trees.

### *Programs and Partnerships*

6. Co-ordination of efforts by private groups and the Government to plant 15 million additional trees over the next 10 years on headwaters, watershed areas, and conservation areas.

7. Establishment of a co-operative effort among the Province, municipalities, and the private sector to plant 5 million trees in municipalities of over 25,000 by 1995 in areas outside of parks and conservation areas. Municipal requirements will be added to Official Plans, plans of subdivision, and zoning by-laws.

8. Establishment of a program to preserve urban trees in all municipalities of over 25,000. Suitable species of trees to absorb carbon dioxide and to reduce cooling needs will be preserved or replaced, and municipal requirements will be added to plans of subdivision and zoning by-laws.



9. Demonstration program to plant fast-growing, salt-resistant trees along major highways.

Efforts by voluntary groups and through private sector partnerships to plant, and to nurture, trees will be important. Many other actions to absorb carbon dioxide are possible. Suggestions from all sectors of the public are encouraged.

## C. Research and Analysis

Much remains uncertain about global warming and how its impacts can be reduced. Research of many kinds will be needed, both to understand the problem better and to solve it. Research and demonstrations at commercial scale are expensive and will require new funding commitments from the public and private sectors. Co-operative efforts are desirable.

Commitment to research will have the double benefit of addressing global warming and improving economic competitiveness. Global warming provides opportunities for co-operative research and demonstration, between governments and with the private sector. The federal government has played, and should maintain, a strong traditional role in supporting research activities. Funds for research should be earmarked from any revenues collected for environmental reasons.

The following research projects are proposed to address the greenhouse effect and global warming.

### *Understanding the Phenomenon*

1. Ontario-based climate research to understand the possible causes and types of climate changes induced by human activities. This effort will be co-ordinated with the Canadian Climate Program operated by the federal Department of Environment. Simulation modelling of global climate is a part of the federal effort; more extensive data collection and theoretical analysis are needed.

2. Extensive research, including the use of scenarios, into the possible impacts of global warming in Ontario on:

- energy demand and supply
- water quality and availability
- forestry and vegetation
- agriculture
- natural habitat and wetlands
- air quality
- the Ontario economy.

Some impacts will be favourable, most will not. The pace of change itself must be better understood so that adaptation steps, if needed, can be taken. The combinations of impacts that might quicken or slow global warming must be better understood.

3. Accurate estimates of methane emitted because of human activities. Leakage of methane from the natural gas transmission and distribution system requires study.

4. Comparison of the greenhouse gas emissions from the use of different fuels, from their production stage to the point of end use. For example, the combustion of natural gas in vehicles contributes less to the greenhouse effect than the combustion of gasoline, but the production of natural gas involves emissions of both carbon dioxide and methane.

5. Technical analyses of the greenhouse effects of organic composting compared with nitrogen-based fertilizers under Ontario conditions. Composting involves emissions of methane, while fertilizers release nitrous oxide into the air and pollute water supplies. Agricultural soils have lost carbon content over the years, and ways to improve soil fertility and to sequester carbon in agricultural soils require study.

6. Technical analyses of the role of wetlands in the greenhouse effect. Vegetation in wetlands, which are desirable for many other ecological reasons, absorbs carbon dioxide while growing, and decay processes emit high levels of methane.

7. Research into steps needed to adapt to global warming. Different agricultural species, changed supplies of water, and altered forest management practices are examples of areas for research.

### *Controlling Emissions*

8. Research and development of energy-efficient refrigerating systems without use of CFCs as refrigerants or in insulation. CFCs deplete the ozone layer and are greenhouse gases, but they have also been important in improving the energy efficiencies of refrigerating and air conditioning systems. Ontario's producers of freezers have been among the world leaders in energy efficiency, and it is important that they remain so. The role of gas-fired absorption air conditioning, as part of cogeneration systems, also requires research.

9. Coal combustion research. While the burning of coal releases more carbon dioxide than the burning of nearly all other fossil fuels, the abundance of coal world-wide means that it is an energy source too important to be abandoned, especially by the developing countries. Significantly improved energy efficiency through Canadian technology would reduce greenhouse gases not just at home, but also abroad. The burning of coal in combustion turbines, by gasifying the coal or by using fluidized bed combustion, together with injection of high pressure steam to increase efficiency and power output or heat recovery by "combined cycles", may raise efficiencies by more than a third compared with current levels in conventional steam turbines.



10. Research and demonstration of replacements for metallurgical coal in the steel industry. Large amounts of carbon dioxide are emitted by

the steel industry in the use of coking coal. New technologies and the use of natural gas can reduce emissions by more than half.

11. Analysis of integrated control strategies for emissions from the burning of fossil fuels, in stationary plants and in vehicles. The burning of fuels releases many products other than carbon dioxide, including sulphur oxides and nitrogen oxides that lead to acid rain, ozone formation, and smog. Separate controls for each kind of emission from each source will be less effective than an integrated control strategy emphasizing energy efficiency of all sources.

12. Research and development of emissions controls, without loss of fuel economy, for diesel engines. Diesel engines are more efficient than internal combustion engines using gasoline or alternative fuels, but diesel engines emit smoke and carcinogens. Cleaner diesel engines for buses and heavy trucks are required to improve air quality in urban areas; they would also provide major opportunities for increased energy efficiencies of light trucks.

13. Technical and economic research on means to capture and dispose of carbon dioxide emissions from combustion processes and to reduce atmospheric concentrations.

### *Reducing Atmospheric Levels of Carbon Dioxide*

14. Research into the absorption and storage—"sequestering"—of carbon dioxide by trees. Different species will be suitable in different parts of Ontario. Urban tree planting will be most successful with a variety of species. The costs, land requirements, survival rates, and energy requirements all require study.



15. Analysis of how best to utilize trees after their initial period of fast growth. The capacity of young, growing trees to absorb carbon dioxide is high. Mature and decaying trees may increase the emissions of greenhouse gases. Trees beyond their early growth stage

could be used for construction or could be burned. Burning biomass from trees also emits carbon dioxide, but if the biomass displaces fossil fuels and if replacement trees are planted, there will be a net reduction in greenhouse gas emissions.

16. Economic analyses of the use of biomass for energy, whether by growing tree plantations for fuel, by growing wheat or corn for ethanol production, or by more burning of pulping liquors. Production of alcohol from waste paper to supplement paper recycling efforts may also be economic.

### *Analysis*

17. Analyses of marketing and development opportunities to share the results—in technologies, in institutions, in education—of Ontario's actions to limit global warming with others in the international community.

18. Development of projects and educational materials for schools and the general public. For example, the planting and ongoing care of tree groves by students might be a source of continuing learning and motivation in the community.

19. Analysis of the research and development needs for energy supply systems that do not burn fossil fuels. These include renewable energy technologies, energy storage, fuel cells for electric power generation, fusion, inherently safe nuclear technologies, and hydrogen produced from nuclear power.

20. Analysis of market mechanisms to provide incentives to reduce emissions of greenhouse gases. Such mechanisms could include tax treatment and tradeable emissions permits. Examples of tax treatment include:

- extending the graduated "gas guzzler" tax to vehicles with fuel economy ratings lower than 9.5 litres/100 km, including off-road sports vehicles, vans, and light trucks;
- extending the Provincial Sales Tax to all forms of energy, which are currently exempted;
- exempting energy-efficient materials like insulation;
- establishing some form of "carbon tax" on fossil fuels on a national basis; and
- establishing a tax on the use of new, unrecycled CFCs to accelerate recovery and recycling.

Furthermore, the use of emissions permits for carbon dioxide could provide incentives to reduce the burning of fossil fuels.

21. Analyses of the energy embodied in manufactured materials, and their potential for re-use through recycling.

22. Analysis of the effectiveness of "gas sipper" rebates, which would be provided to buyers of new, fuel-efficient vehicles who trade-in less fuel-efficient vehicles to be junked.

23. Analysis of means to improve the fuel efficiency of new automotive vehicles by at least 35 per cent compared with vehicles currently being produced. Federal legislation, not yet enacted, could be used to set challenging fleet-average fuel efficiency requirements. The automotive industry prefers the voluntary guidelines now in place.

24. Alternatives to the combustion of fossil fuels, especially in vehicles. Electricity and alcohols from biomass may be ready for wider market adoption in transportation. Many earlier claims have proved premature, but the technologies and economics of alternatives require review in light of global warming. Analyses of factors affecting consumer acceptance are needed.

25. Analyses of public attitudes towards switching from the use of private autos to public transit in support of environmental improvement.

26. Studies to identify the transportation sectors and corridors where shifts to more energy-efficient modes, for passengers and freight, can be made. Structural, regulatory, and behavioural barriers to modal shifts need to be identified.

27. Economic analysis of periodic inspections of vehicles and residential furnaces to ensure compliance with efficiency, not just environmental, requirements.

28. Analysis of the effectiveness under Ontario conditions of a range of market mechanisms such as taxes or peak-hour charges compared with regulatory steps affecting transportation behaviour in urban areas. Examples are:

- charges for road use in peak-hours compared with acceptance of only small, fuel-efficient vehicles downtown; and
- the comparative effectiveness of increased fuel taxes, "gas guzzler" tax, higher fuel efficiency requirements for vehicles, and fuel rationing.

29. Analysis of innovative sources of funding for construction of public transit systems, including federal and private sector contributions. Public transportation rarely pays for itself through revenues from fares, even for operating expenses alone. Greater investment in public transportation and the design of urban areas will be required to address global warming.



30. Analysis of incentives and requirements for municipalities to take actions to limit global warming. Current mechanisms to encourage municipalities to follow Provincial policies and guidelines may not be adequate to ensure actions such as linking infrastructure construction

with densities to support public transit. And many actions to reduce global warming may require new funding, which would be conditional upon performance.

31. Analysis of rate structures and rate designs to encourage efficient use of resources supplied by utilities—electric power, natural gas, and water.

32. Analyses of least-cost means to transfer efficient energy technologies to developing countries, so that large efficiency improvements occur where energy demand is growing rapidly.

# IV. WHAT YOU CAN DO

*"The action is all, the glory nothing."*

—J. W. von Goethe

Reducing the net emissions of greenhouse gases into the air will limit the impacts of global warming, but the effects are long-term. Thus the "credit" for limiting global warming will remain hard to see. Taking actions—many of which are justified for other reasons—is the responsibility of each of us, as citizens and as private or public agencies.

The Action Steps proposed in this discussion paper are for the Ontario Government but are enabling steps. They are directional and would go part of the way in fulfilling the recommendations of the Toronto Conference on the Changing Atmosphere. Many more actions in our society will be needed to limit global warming and to reach the first step of reducing annual emissions of the greenhouse gases to their levels in 1989.

As individuals, we each can:

1. use energy efficiently in daily life
2. invest in energy-efficient equipment
3. recycle materials made from, or made using, fossil fuels, such as plastic bags and steel
4. use public transportation more often

5. advise others on energy-saving practices

6. inquire whether goods such as foam packaging and furniture cushions involve CFCs in their production

7. become aware of personal contributions to greenhouse gas emissions such as 5 tonnes of carbon dioxide per year from the typical family auto

8. estimate our annual personal contributions to greenhouse gases and compare with international averages

9. take part in community actions to plant and nurture trees

10. advise governments of all levels on steps to take.

This discussion paper is only a beginning. It lays out some proposals of the Ontario Government. But Ontario's contributions to reducing global warming will depend on the reactions of citizens and businesses to this proposed strategy. Please send your views and suggestions.

*Please call:*

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in Toronto **965-3246**

*or write to:*

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